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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/848,397	05/03/2001	Yi Ding	200-0720	7721

22844 7590 02/03/2003

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EXAMINER

YUAN, DAH WEI D

ART UNIT	PAPER NUMBER
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1745

DATE MAILED: 02/03/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/848,397

Applicant(s)

DING ET AL.

Examiner

Dah-Wei D. Yuan

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-24 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). ____.
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2. 6) ☐ Other: .

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**FUEL CELL POWER PLANT WITH ELECTROCHEMICAL
ENHANCED CARBON MONOXIDE REMOVAL**

Examiner: Yuan

S.N. 09/848,397

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January 24, 2003

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 2-24 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

3. The term "rapid dynamic response" in claim 2 is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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5. Claims 1-16,21-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rehg et al. (US 6,245,214) in view of Vayenas (Ionic and Mixed Conducting Ceramics, 509-529 (1998)).

Rehg et al. teach a fuel cell system comprising a CO removal system and a fuel cell stack. In general, a hydrocarbon fuel source, such as gasoline, natural gas or methanol (hydrogen fuel), is introduced into a fuel processor. In the fuel processor, the hydrocarbons can react with air or water through partial oxidation or steam reforming to form a reformat mixture containing hydrogen, carbon monoxide, carbon dioxide, water and other minor components. The reformat mixture undergoes additional steps of catalytic reactions, such as a water-gas-shift reaction to further promote the reaction between steam and CO to form hydrogen and CO₂. See Column 5, Lines 26-40; Figure 1.

However, Rehg et al. do not teach the use of electrochemical promotion to remove the CO in the reactant. Vayenas et al. teach a non-Faradaic electrochemical modification of catalytic activity using ionic and mixed conducting ceramics. It is found that the catalytic activity and selectivity of metal films deposited on solid electrolytes can be altered dramatically and reversibly by applying an electrical current or potential between the metal catalyst film and a second film deposited on the solid electrolyte. One of the technological possibilities is in exhaust gas treatment. As a result, the controlled migration of ions from the electrolyte to a gas-exposed catalyst electrode surface under the influence of current can reduce the CO. Therefore, it would have been obvious to one of ordinary skill in the art to use electrochemical promotion to remove CO in the fuel cell system of Rehg et al., because Vayenas et al. teach the non-Faradaic

electrochemical modification can significantly improve the catalytic activity and, thus the efficiency of CO removal. With regards to claims 2,3,4,14,15,16,21, the catalyst working electrode can be Pt, Pd, Rh, Ag, Ni or Au. With regards to claims 5-12, a galvanostat or potentiostat is used to apply constant currents between the catalyst and counter electrode or constant potentials (voltage). With respect to claim 2,13, the operation temperatures from ambient to 370°C using YSZ is considered to be a wide temperature range. The voltage and current are generic terms, which individually comprises AC and DC. With regards to claims 22-24, battery, potentiostat and galvanostat are considered functionally equivalent power sources. Therefore, it would have been obvious to one of ordinary skill in the art to substitute a battery for the potentiostat (or the galvanostat) to provide power in the CO removal system of Vayenas et al. See Pages 509-511,522.

6. Claims 1-13,22-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rehg et al. (US 6,245,214) in view of Yentekakis et al. (Ionics, 1(5&6), 491-498 (1995)).

Rehg et al. teach a fuel cell system comprising a CO removal system and a fuel cell stack. In general, a hydrocarbon fuel source, such as gasoline, natural gas or methanol (hydrogen fuel), is introduced into a fuel processor. In the fuel processor, the hydrocarbons can react with air or water through partial oxidation or steam reforming to form a reformat mixture containing hydrogen, carbon monoxide, carbon dioxide, water and other minor components. The reformat mixture undergoes additional steps of catalytic reactions, such as a water-gas-shift reaction to

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further promote the reaction between steam and CO to form hydrogen and CO₂. See Column 5, Lines 26-40; Figure 1.

However, Rehg et al. do not teach the use of electrochemical promotion to remove the CO in the reactant. Yentekakis et al. teach the rates of CO, H₂, CO₂ and carbon formation exhibit pronounced non-Faradaic or electrochemical promotion behavior. It is found that the catalytic activity of CO can be altered by applying an electrical current or potential between the metal catalyst film and a second film deposited on the solid electrolyte. Figures 7-10 show the activity of CO can be decreased by promoting the deposition of carbon in the fuel cell reactor of Figure 2. Therefore, it would have been obvious to one of ordinary skill in the art to use electrochemical promotion to remove CO in the fuel cell system of Rehg et al., because Yentekakis et al. teach the non-Faradaic electrochemical modification can significantly reduce the CO activity and, thus improve the efficiency in the removal of CO. With regards to claims 2,3,4, the working electrode is a Ni (catalyst) deposited YSZ cermet. Perovskite is the counter electrode. With regards to claims 5-12, a galvanostat or potentiostat is used to apply constant currents or constant potentials (voltage) between the catalyst and counter electrode (see figure 2). The voltage and current are generic terms, which comprise AC and DC, respectively. With regards to claims 22-24, battery, potentiostat and galvanostat are considered functionally equivalent power sources. Therefore, it would have been obvious to one of ordinary skill in the art to substitute a battery for the potentiostat (or a galvanostat) to provide power in the CO removal system of Yentekakis et al. See Pages 491-493,496-498; Table 1.

Allowable Subject Matter

7. Claims 17-20 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims. Claim 17 would be allowable because the prior art does not disclose or suggest the use of Cu/ZnO catalyst as the working electrode. Claim 18 would be allowable because the prior art does not disclose or suggest the use of Cu/CuO catalyst as the working electrode. Claim 19 would be allowable because the prior art does not disclose or suggest the use of ABO_3 (perovskite) catalyst as the working electrode. Claim 20 would be allowable because the prior art does not disclose or suggest the use of zeolite catalyst as the working electrode.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dah-Wei D. Yuan whose telephone number is (703) 308-0766. The examiner can normally be reached on Monday-Friday (8:00-5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan, can be reached on (703) 308-2383. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.


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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Dah-Wei D. Yuan
January 24, 2003



Patrick Ryan
Supervisory Patent Examiner
Technology Center 1700